PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 : H04Q 7/38	A1	(11) International Publication Number: WO 00/38465 (43) International Publication Date: 29 June 2000 (29.06.00)

(21) International Application Number: PCT/SE99/02323

(22) International Filing Date: 10 December 1999 (10.12.99)

(30) Priority Data:
09/215,118 18 December 1998 (18.12.98) US

(71) Applicant: TELEFONAKTIEBOLAGET LM ERICSSON (publ) [SE/SE]; S–126 25 Stockholm (SE).

(72) Inventors: SULTANA, Shabnam; Petersson, Bornholmsgatan 2, 3tr., S–164 46 Kista (SE). MADOUR, Lila; Grimson, Kranborsgränd 14, 2tr., S–164 46 Kista (SE).

(74) Agent: KLAS, Norin; Ericsson Radio Systems AB, Common Patent Dept., S–164 80 Stockholm (SE).

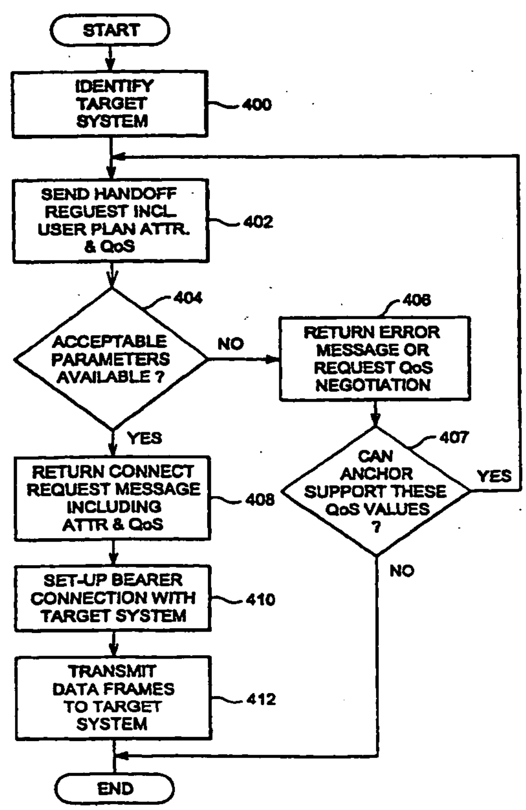
(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: METHOD AND SYSTEM FOR INTERSYSTEM SOFT HANDOFF

(57) Abstract

Inter–system soft handoff support is described using, as an example, a modified set of ANSI41 signaling techniques in conjunction with a packet data transport mechanism (e.g., TCP/IP or ATM) to carry the user data between systems. An anchor system sets up the soft handoff by indicating, among other things, one or more sets of user plane attributes available to interface the anchor system with a target system(s). Quality of service levels are also indicated and may be negociated between systems.



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece			TR	Turkey
BG	Bulgaria	HU	Hungary	ML	Mali	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MN	Mongolia	UA	Ukraine
BR	Brazil	IL	Israel	MR	Mauritania	UG	Uganda
BY	Belarus	IS	Iceland	MW	Malawi	US	United States of America
CA	Canada	IT	Italy	MX	Mexico	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NE	Niger	VN	Viet Nam
CG	Congo	KE	Kenya	NL	Netherlands	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NO	Norway	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	NZ	New Zealand		
CM	Cameroon			PL	Poland		
CN	China	KR	Republic of Korea	PT	Portugal		
CU	Cuba	KZ	Kazakstan	RO	Romania		
CZ	Czech Republic	LC	Saint Lucia	RU	Russian Federation		
DE	Germany	LI	Liechtenstein	SD	Sudan		
DK	Denmark	LK	Sri Lanka	SE	Sweden		
EE	Estonia	LR	Liberia	SG	Singapore		

METHOD AND SYSTEM FOR INTERSYSTEM SOFT HANDOFF

BACKGROUND

The present invention generally relates to increasing data throughput and quality in a wireless communication system and, more particularly, to systems and methods involving adaptation of soft handoff between radiocommunication systems.

The growth of commercial communication systems and, in particular, the explosive growth of cellular radiotelephone systems have compelled system designers to search for ways to increase system capacity without reducing communication quality beyond consumer tolerance thresholds. At the same time usage of mobile communication equipment for transmission of data rather than speech has become increasingly popular by consumers. The ability to send and receive electronic mail and to use a web browser to obtain world-wide-web access is frequently discussed among services that will be used more and more in wireless communication systems. In addition to data communications, subscribers are coming to expect greater roaming capability, i.e., the capability to move around geographically and continue to be supported in their radiocommunication service.

Many radiocommunication systems have been designed in accordance with various standards, e.g., adopted on a country-wide or region-wide basis, in order to provide a roadmap for technological and service compatibility. For example, D-AMPS (ANSI136) has been specified for North America, GSM for Europe and PDC for Japan. However, systems created in accordance with these standards have migrated beyond the geographical areas in which they arose. For example, both GSM-type systems and ANSI 136 type systems are currently employed in the United States. Thus, in considering ways to provide continuous radiocommunication service, designers should also take into account existing standards in an effort to minimize the impact of design changes on the relevant standard(s) and legacy equipment. Likewise, systems offered by different manufacturers should also be able to provide inter-system radiocommunication service support.

When a mobile station moves from the service area of one radiocommunication system into the service area of another radiocommunication system, a handoff to the new system must be provided in order to maintain the connection. While cellular systems were originally designed to operate with one-to-one correspondence between a mobile station and an associated base station covering a geographic cell, i.e., a handoff was performed from one serving base station to one target base station, it has been determined that the effects of shadowing and fading can be reduced by communicating the same signal to a mobile station over more than one link, e.g., to and from more than one base station.

Moreover, in systems using fast power control, like code division multiple access (CDMA) and wideband CDMA (WCDMA) systems, a one-to-one correspondence would result in a low capacity compared to communication over more than one link. To overcome this, a multi-link communication can be established, both in the up- as well as the downlink, so that two or more base stations communicate the same information to a mobile station over two different links. For the downlink this means that transmission occurs from two or more base stations and in the uplink two or more base stations listen to signals transmitted from mobile station. The mobile station processes the signals from the two links by selecting or combining them in some way, e.g., maximal ratio combining.

This technique is known as diversity or macrodiversity. Conventional spatial diversity techniques employ two or more separated antennas in a single base station, or two or more base stations, to communicate with a mobile station. However, diversity is not limited to spatially offsetting base stations or antennas (i.e., multiple transmission paths). Diversity transmission can also be generated using one or more of an offset in time, polarization, frequency or code.

One area in which macrodiversity is commonly practiced is during handoff. In such cases, the candidate base station (i.e., the base station to which a mobile station is to be handed off) starts transmitting substantially the same message information to the mobile station before the current, serving base station terminates its transmission of that

message information. This usage of macrodiversity is commonly referred to as soft handoff. Soft handoff is described in U.S. Patents No. 5,109,528 to Uddenfeldt and No. 5,327,577 to Uddenfeldt, both of which are expressly incorporated here by reference.

Figure 1 illustrates a soft handoff arrangement wherein a first, original base station **202** and a second, candidate base station **204** each transmit a same message **206** to a mobile station **208**. The message **206** is transmitted to the mobile station **208** over different signal paths in the forms of a first downlink **210** and a second downlink **212**. The first and second downlink signals **210** and **212** are recombined (or one of the received signals is selected) in the mobile station **208** to extract the message **206**. The mobile station **208** transmits to the base stations **202** and **204** over first and second uplink paths **214** and **216**, respectively. At some point in time, the transmission of message information to the mobile station from the first, original base station **202** is terminated and the soft handoff process is concluded.

In a soft handoff arrangement, the base stations and/or antennas communicating with a particular mobile station are known as "active set" members. For example, referring back to Figure 1, base stations **202** and **204** would be considered members of the active set. Those skilled in the art will appreciate that more than two base stations and/or antennas can be part of the active set. Members of an active set can change as the mobile station passes into and out of coverage areas handled by base stations and/or antennas in the system.

Soft handoff has been used in many different types of radiocommunication systems, including those using time division multiple access (TDMA) and CDMA. Soft handoff increases robustness, achieves improved downlink quality, and combats fading. However, soft handoff between different systems, e.g., base stations associated with different mobile switching centers (MSCs) has not been given thorough consideration.

Moreover, today there exists no scheme to allow a packet data call to be handed off between systems without disrupting the service. Instead, the connection between the anchor system and the terminal is broken during the handoff process. The terminal

performs a new packet data registration in the new system after which a new packet data connection is re-established.

Some attempts can be found, however, in the literature regarding techniques for providing intersystem soft handoffs. For example, WO 97/41698 to Lee et al. describes a technique for intersystem soft handoff between CDMA systems wherein a new signaling protocol is described to perform soft handoff. More specifically, intersystem soft handoffs are described wherein the signaling associated with performing the handoff is conducted over a T1 or E1 line using HDLC data protocol. This document provides a rather narrow solution that is limited in terms of signaling transport support and its requirement for a new signaling protocol.

Another solution is found in WO 98/18282 to Abu-Amara et al. wherein a virtual router is created between the source and target BTSs, which are associated with different systems. According to this document, establishment of this virtual router permits inter-MSC soft handoffs to be accomplished in the same manner as intra-MSC soft handoffs. However, this system is limited to providing handoff signaling between base stations, instead of between MSCs (although the MSCs are interconnected via voice trunks). Moreover, both of the aforedescribed techniques are not optimized for usage with systems which use Internet Protocol (IP) signaling and do not provide support for intersystem handoff of packet data connections.

Accordingly, Applicants have determined that it would be desirable to provide an intersystem soft handoff technique which avoids the drawbacks associated with previous solutions to the problem of interfacing systems for this task and which permits mobile users to travel between different systems while receiving seamless radiocommunication service.

SUMMARY

These and other drawbacks and limitations of conventional methods and systems for communicating information are overcome according to the present invention, wherein Applicants present techniques and systems to enhance intersystem soft handoffs

based on a modified set of ANSI41 signaling techniques (although other NNI protocols like GSM MAP are not excluded) in conjunction with packet data (e.g., ATM or IP) bearer protocols for data transport. According to an exemplary embodiment of the present invention, once an anchor system has identified one or more target systems, a handoff request message is sent to the target system(s). The handoff message includes, among other parameters, at least one set of user plane attributes and at least one quality of service (QoS) values associated therewith. These attributes specify, at least in part, the possible mechanisms by which the anchor system is willing to establish the diversity connection. For example, the anchor system can specify two sets of user plane attributes: one set including Internet Protocol (IP) transport information and another set including asynchronous transfer mode (ATM) transport information. Transmitted along therewith may be associated QoS values, e.g., one or more for the IP transport mechanism and one or more for the ATM transport mechanism.

The recipient target system(s) may evaluate the received parameters and determine if their current resources and capabilities provide a match with one or more of the sets offered by the anchor system. If so, each target system sends a connection request indicating which set of attributes have been selected and a connection is set up to that system to enter the soft handoff mode. Otherwise, a target system which cannot accept the received parameters returns a rejection message.

Some parameters offered by the anchor system may be negotiable. For example, if a target system cannot provide the requested QoS, then it may return (with its rejection message) a suggested QoS under which it could provide service to the mobile station. If accepted by the anchor system, soft handoff mode may then be entered using this negotiated QoS.

By using the scheme of call control separation from the connection control, exemplary embodiments of the present invention are adaptable to handoff between different access network technologies including, for example, W-LAN, bluetooth, x_DSL, GSM, etc. In order to communicate between two access network technologies,

the data relevant to the terminal capability that will allow change of terminal mode would be added in the relevant messages.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other objects, features and advantages of the present invention will become more apparent upon reading from the following detailed description, taken in conjunction with the accompanying drawings, wherein:

FIG. 1 depicts a soft handoff mode of operation involving two base stations;

FIG. 2 illustrates an exemplary intersystem soft handoff scenario which is used to illustrate soft handoff signaling according to the present invention;

FIG. 3 is a signaling diagram illustrating exemplary signaling between two target systems and an anchor system in performing soft handoff according to an exemplary embodiment of the present invention; and

FIG. 4 is a flowchart depicting steps of an exemplary soft handoff method according to an exemplary embodiment of the present invention.

DETAILED DESCRIPTION

The following exemplary embodiments are provided in the context of CDMA radiocommunication systems. However, those skilled in the art will appreciate that this access methodology is merely used for the purposes of illustration and that the present invention is readily applicable to all types of access methodologies including, for example, frequency division multiple access (FDMA), time division multiple access (TDMA), code division multiple access (CDMA), wideband local area networks (WLAN), "Bluetooth" radio data communication and hybrids thereof.

A system in this document can be considered as a network including routers/switches (MSC), gateways with conversion capabilities (media gateways), application nodes (or servers) such as call control or media control, services and management. The system architecture uses the concept of separation of call control (media control), also referred to as the control plane, from the connection control

(gateway/routers), also referred to as the user plane. A candidate protocol for inter-system call control protocol in exemplary embodiments is ANSI41. Given that this protocol is currently widely used by many wireless operators in the world, it would be easier to build on such an existing protocol rather than developing new protocols that require operator re-investment in new equipment. For example, SS7/IP gateways will soon exist where ANSI41 can be carried over IP in the protocol stack

Since soft handoff involves transmitting substantially the same information from multiple transmission sources at substantially the same time, the overhead signaling which takes place across the network to coordinate the processing of soft handoff mode is substantial. According to exemplary embodiments of the present invention, mentioned above, signaling between systems engaging in a soft handoff is performed using a modified version of the signaling described in ANSI41 for hard handoff. ANSI41 is a standard promulgated by TIA/EIA for communication between different radiocommunication systems, i.e., between MSCs of different systems. This standard describes various high level application services (referred to as the Mobile Application Part or MAP) including, for example, roaming, handoff, authentication, call delivery and teleservices (e.g., short message service). MAP is at the top of a protocol stack defined for signaling between systems, which protocol stack also includes other familiar OSI layers associated with data transfer including a physical layer, a data link layer and a network layer, which layers can be implemented in a number of ways, e.g., using SS7 or X.25 protocols.

Consider the exemplary post soft-handoff situation depicted in Figure 2, wherein three base stations are currently in the active set of a particular mobile station. Specifically, a base station **220** supports radiocommunication services in a first cell, base station **230** supports radiocommunication services in a second cell and base station **240** supports radiocommunication services in a third cell. Each of the base stations **220**, **230**, and **240** are in communication with the rest of the fixed portion of the radiocommunication network via a respective mobile switching center (MSC) **250**, **260** and **270**. In the example illustrated in Figure 2, MSC **250** is referred to as the "anchor"

system since it was originally supporting radiocommunications with mobile station (MS) **280** by itself prior to the soft handoff which added the other two communication branches. (In this particular example, the original server (BS **220**) is still part of the active set, so the part of the "handoff" involving releasing the original server has not yet occurred.) The links between each of the base stations and their respective systems may, for example, be embodied as optical links which transfer information using pulse code modulated (PCM) slots.

The transmission of information between the base stations and, for example, mobile station **280** occurs over an air interface. For the purposes of this exemplary embodiment, consider that the air interface associated with the system depicted in Figure 2 operates using a CDMA technology with duplexed downlink (i.e. base-to-mobile direction) and uplink (i.e. mobile-to-base direction) channels. In the context of this exemplary CDMA system, a physical channel is identified by its code (i.e., short, long or combination thereof), frequency and bandwidth. Purely for illustrative purposes, such an air interface can be that described in "Mobile Station-Base Station Compatibility Standard for Dual-Mode Wideband Spread Spectrum Cellular System," TIA/EIA Interim Standard TIA/EIA/IS-95 (July-93) and its revision TIA/EIA Interim Standard TIA/EIA/IS-95-A (May 95) as set forth by the Telecommunications Industry Association and the Electric Industries Association located in Arlington, Virginia.

As is well known in the art, each mobile station will monitor the transmissions of neighboring sources, e.g., base stations, while it is connected to the system. For example, information regarding the received signal quality and/or strength is returned to the system and used to place these neighboring sources in that mobile station's candidate set. At certain times, one or more of the sources in the candidate set may be added to the active set. For example, in many systems and particularly CDMA systems, when a mobile station approaches a cell boundary, the mobile station may enter a region wherein another transmission source (e.g., another base station) begins to transmit substantially the same information to that mobile station. The mobile station can then combine the plural received signals to create a composite that has better quality than

that which would have resulted from only receiving the information from one source. Further, since the power control is fast enough to track the Rayleigh fading, soft handover will also reduce the interference in the system, which is particularly important in the uplink.

In the example of Figure 2, base stations **230** and **240** have been added to the mobile station **280**'s active set based on such monitoring. However, since base stations **230** and **240** belong to a different system than current serving base station **220**, an intersystem soft handoff procedure according to the present invention is implemented as will now be described with respect to the signaling diagram of Figure 3 and flowchart of Figure 4 (which indicates some of the higher level functions performed by the signals of Figure 3).

Therein, the signaling involved in performing a soft handoff to two target systems from an anchor system according to an exemplary embodiment of the present invention is illustrated. In such a point-to-multipoint soft handoff scenario between an anchor system and plural target systems, the anchor system first decides that one or more cells at one or more target systems are needed to support the call in soft-handoff at step **400** (Figure 4). This step is indicated by the HANDOFF REQUIRED message transmitted in Figure 3 from BS1 to MSC1 within the anchor system. Next, the anchor system sends a new soft handoff request operation SOFT_FACDIR Invoke to each target system (step **402**). The SOFT_FACDIR message as specified according to an exemplary embodiment of the present invention can include multiple parameters, for example, (1) the call ID of the connection, (2) the user plane attribute, (3) at least one quality of service (QoS) value, (4) the channel identity, (5) the cell identifier list (if more than one base station is to be added to the active list at a target system(s)), (6) band class, (7) the diversity unit ID, (8) the mobile station identification data (e.g., IMSI (international mobile station identifier), ESN (Electronic serial number)), (9) downlink signal strength, and (10) service option (or service configuration record).

Some of these parameters will require little or no explanation for those skilled in the art, e.g., IMSI and ESN, while others are less self-explanatory. For example, each

connection is assigned a reference number referred to above as the "call ID" by which number the connection can be tracked throughout a system.

The user plane attribute parameter contains information regarding various mechanisms by which user data can be transferred between the anchor system and the target system(s) including transport type (i.e., bearer), address type and address value. Examples of such transport types include: TCP/IP, Point-to-Point Protocol (PPP), IETF MPLS (Multi-protocol label switching), tunneling protocols such as IETF L2TP protocols, asynchronous transfer mode (ATM), etc. Address types include, e.g., IPV4, IPV6, ATM NSAP, E.164, etc. Then, corresponding to each address type, the SOFT_FACDIR includes an address value for the anchor System. Thus, the user plane attribute parameter can include a plurality of sets of (transport type, address type, address value) from which target system(s) can elect to receive/transmit data between the systems in a particular manner. In other words, call control protocols according to the present invention allow both the anchor system and target system(s) to negotiate and establish which transport technology to use.

The quality of service (QoS) parameter included in the SOFT_FACDIR message will vary depending upon the type(s) of transport or routing protocols offered in the user plane attribute parameter. According to one exemplary embodiment of the present invention, each transport type identified in the user plane attribute parameter will have a set of corresponding QoS values in this part of the SOFT_FACDIR message (where the word "set" is inclusive of one). For example, if the user plane attribute parameter identifies ATM and IP as two different transport protocol types which are available for target systems to select as bearer mechanisms for handling the user data in a soft handoff, then the QoS parameter might include values associated with cell delay and cell peak delay for the ATM option and bit error rate and time delay for the IP transport option.

The channel identity parameter may be expressed as a channel number, frequency and/or spreading code associated with the connection. The cell identifier list can include, for example, the coded digital verification color code (CDVCC), long

scrambling code, etc., associated with a particular base station. The band class indicates the frequency hyperband within which the mobile station is operating in regions which support multiple hyperbands, e.g., cellular and PCS bands. The diversity unit ID identifies an address of the unit which performs the combining of received information on the uplink. The downlink signal strength informs the target system(s) of the current transmit power at which the serving base station is transmitting on the downlink. Lastly the service option provides information as described in TIA/TSB58.

The target system(s) (e.g., MSCs **260** and **270**) receive the SOFT_FACDIR and query the affected base stations using the Handoff request signal in Figure 3. Within each target system, a determination is made (step **404**) as to whether an acceptable set of parameters is being offered by the anchor system for the soft handoff, e.g., whether the user plane attribute and QoS parameters include values that each target system can support. If not, then a return error message (step **406**) associated with the SOFT_FACDIR will be returned to the anchor system indicating, for example, congestion, service not available (attempt hard handoff), and/or transport type not supported by target system. Alternatively, the target system may request QoS negotiation based on a new QoS value. If the anchor system can support this new QoS value (step 407), then it is forwarded to the anchor system. When a QoS negotiation is returned, the anchor system may transmit a new SOFT_FACDIR message including the QoS value to the target system(s), i.e., indicating that the QoS value suggested by the target system(s) is acceptable to the anchor system.

If, on the other hand, the original SOFT_FACDIR message includes parameters that are acceptable to the target system(s), then each target system(s) selects one of the sets of available user plane attributes from the SOFT_FACDIR message and a corresponding QoS. The target system(s) can also verify the identified service option and validate the cell identifier list found in the SOFT_FACDIR.

The target system(s) will then send a new message SOFT_CONNECT_REQUEST (step **408**) in response to the SOFT_FACDIR to the

anchor system including the selected transport attribute and the corresponding destination transport addresses of the target cell(s) (or base transceiver systems (BTSs)). This message also includes a connection request using the provided transport address(es) to be setup. The anchor system successfully acknowledges with a return result (no parameter included and not shown in Figure 3) and starts establishing the user plane connection(s) using the provided address(es) and transport protocols received from the target system(s) (step **410**). Note that, depending upon the target system(s) involved, it is entirely possible that the anchor system could use one set of selected attributes to direct soft handoff connection data to a first target system and another set of selected attributes to direct soft handoff connection data to a second target system.

Once the connection or session is opened, the anchor system starts forwarding user data frames to the target system(s) on each connection (step **412**). The frames are forwarded to the MS **280** on the forward traffic channel from each target cell. The target system(s) also acquire reverse traffic channel(s) on the target cell(s). The target system(s) will at this point send responses to SOFT_FACDIR (see Figure 3) back to the anchor system and wait for the handoff completion from the mobile station. The mobile station will first receive a handoff direction message, e.g., as per IS-95, on the forward traffic channel from the anchor system following the response to SOFT_FACDIR that includes information to be sent on the handoff direction message. The mobile station, upon receiving the handoff direction message will include the target cells in the active set. The mobile station will then send a handoff completion message on the reverse traffic channel to both anchor and target system(s). Once the target system(s) receive the handoff completion from the MS, they can send a new message (SOFT_MobOnChannel) back to the anchor system to indicate the completion of the radio link towards the mobile.

When one of the branches is to be released, e.g., after its received signal quality (strength) at the mobile station drops below some predetermined threshold, a SOFT_FACREL message (not shown in Figure 3) can be used to indicate release of a

soft handoff branch. The SOFT_FACREL message includes the address of the corresponding branch.

As mentioned earlier, the present invention is applicable to both real time (e.g., voice over IP/ATM, multimedia conferencing, virtual reality) services and non-real time service (e.g., file transfer, Electronic mail etc.) when mobile wireless hosts (terminals) handoff from one system to another neighbouring system. The real time nature of the traffic is determined by the quality of service specifications. If the traffic flow at handoff is of non-real time nature, best effort delivery could be use din routing the packets from the anchor system to the target system(s). This would be a possible default value in the QoS parameter.

The quality of service required to guarantee the delivery of service includes per-packet/cell delay maximum, and minimum values, offset delay. The target system(s) would determine if they are able to commit to the quality of service currently guaranteed by the anchor system. Depending on the transport technology that would be used to deliver packets between anchor and target system(s), there could be different quality of service values associated to each of the available transport network.

Although the invention has been described in detail with reference only to preferred embodiments, those skilled in the art will appreciate that various modifications can be made without departing from the invention. For example, although two target systems were described above, those skilled in the art will appreciate that more than two target systems or only one target system may be the object of a soft handoff procedure according to exemplary embodiments of the present invention. Moreover, the invention provides techniques for handing off between different access network technologies including W-LAN, bluetooth, x-DSL, GSM, etc. In order to handoff between two access network technologies, data relevant to the terminal capabilities would be added into the message. The capabilities would indicate if the terminal is capable of making an access in the new system. Furthermore, in order to handoff between two dissimilar networks, e.g., from CDMA to GSM using different intersystem call control protocol, the anchor system would locate a gateway within its

own domain, or outside its domain, that would perform the necessary intersystem call control protocol conversion. Accordingly, the invention is defined only by the following claims which are intended to embrace all equivalents thereof.

What is claimed is:

1. A method for performing an inter-system soft handoff of a connection with a mobile station between an anchor radiocommunication system and at least one target radiocommunication system comprising the steps of:

identifying said at least one target system to support said connection;

sending a handoff request to said at least one target system including a quality of service (QoS) parameter, which QoS parameter indicates a desired QoS to be provided by said at least one target system in supporting said connection;

determining, at said at least one target system, whether support is available for said QoS; and

selectively responding to said handoff request with a connection request based on a result of said step of determining.

2. The method of claim 1, wherein said step of sending a handoff request further comprises the step of:

including, in said handoff request, at least one set of transport attributes associated with said anchor system.

3. The method of claim 2, wherein said at least one set of transport attributes includes a transport type, an address type and an address value.

4. The method of claim 3, wherein said transport type includes one of: ATM and IP protocols.

5. The method of claim 2, wherein said step of selectively responding further comprises the steps of:

selecting one of said at least one set of attributes; and

transmitting, as part of said connection request, an indication of said selected at least one set of transport attributes.

6. The method of claim 5, wherein said step of transmitting an indication of said selected at least one set of transport attributes includes the step of:

identifying a selected packet data transport protocol.

7. The method of claim 1, wherein said step of selectively responding further comprises the step of:

transmitting a message with a different QoS than said QoS to initiate negotiation between said anchor system and said at least one target system regarding quality of service to be supported by said at least one target system.

8. A method for performing an inter-system soft handoff of a connection with a mobile station between an anchor radiocommunication system and a at least one target radiocommunication system comprising the steps of:

identifying said at least one target system to support said connection;

sending a handoff request to said at least one target system including a set of user plane attributes indicating at least one transport mechanism available at said anchor system to transfer data to said at least one target system;

determining, at said target system, whether support is available for said set of user plane attributes; and

selectively responding to said handoff request with a connection request based on a result of said step of determining.

9. The method of claim 8, wherein said step of sending a handoff request further comprises the step of:

including, in said handoff request, at least one quality of service (QoS) value associated with said at least one transport mechanism.

10. The method of claim 8, wherein said set of user plane attributes includes a transport type, an address type and an address value.

11. The method of claim 10, wherein said transport type includes one of: ATM and IP protocols.

12. The method of claim 8, wherein said step of selectively responding further comprises the steps of:

selecting said set of user plane attributes; and

transmitting, as part of said connection request, an indication of said selected at least one set of transport attributes.

13. The method of claim 12, wherein said step of transmitting an indication of said selected at least one set of transport attributes includes the step of:

identifying a selected packet data transport protocol.

14. An intersystem connectivity mechanism usable to establish a second link between a second radiocommunication system and a mobile station during a time period while a first link exists between said mobile station and a first radiocommunication system, said intersystem connectivity comprising:

a physical connection between said first and said second radiocommunication systems; and

a signaling protocol for transferring information associated with said physical connection from said first radiocommunication system to said second radiocommunication system,

wherein said signaling protocol includes a set of user plane attributes associated with said physical connection.

15. The intersystem connectivity of claim 14, wherein said connection is a packet data connection.

16. The intersystem connectivity of claim 14, wherein said set of user plane attributes includes a transport type, an address type and an address value.

17. The intersystem connectivity of claim 16, wherein said transport type includes one of: ATM and IP protocols.

18. An intersystem connectivity mechanism usable to establish a second link between a second radiocommunication system and a mobile station during a time period while a first link exists between said mobile station and a first radiocommunication system, said intersystem connectivity comprising:

a physical connection between said first and said second radiocommunication systems; and

a signaling protocol for transferring information associated with said physical connection from said first radiocommunication system to said second radiocommunication system,

wherein said signaling protocol includes at least one quality of service (QoS) value associated with said physical connection.

19. The intersystem connectivity of claim 18, wherein said connection is a packet data connection.

20. The intersystem connectivity of claim 18, wherein said at least one QoS value is based on a transport type associated with said connection.

21. The intersystem connectivity of claim 20, wherein said transport type includes one of: ATM and IP protocols.

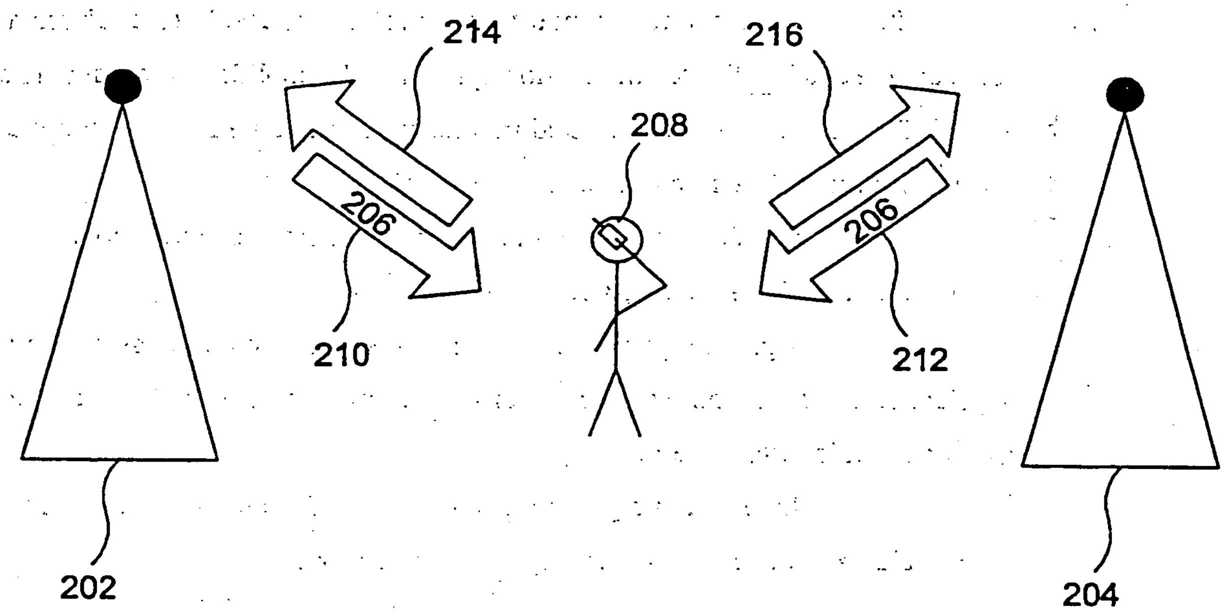


Fig. 1

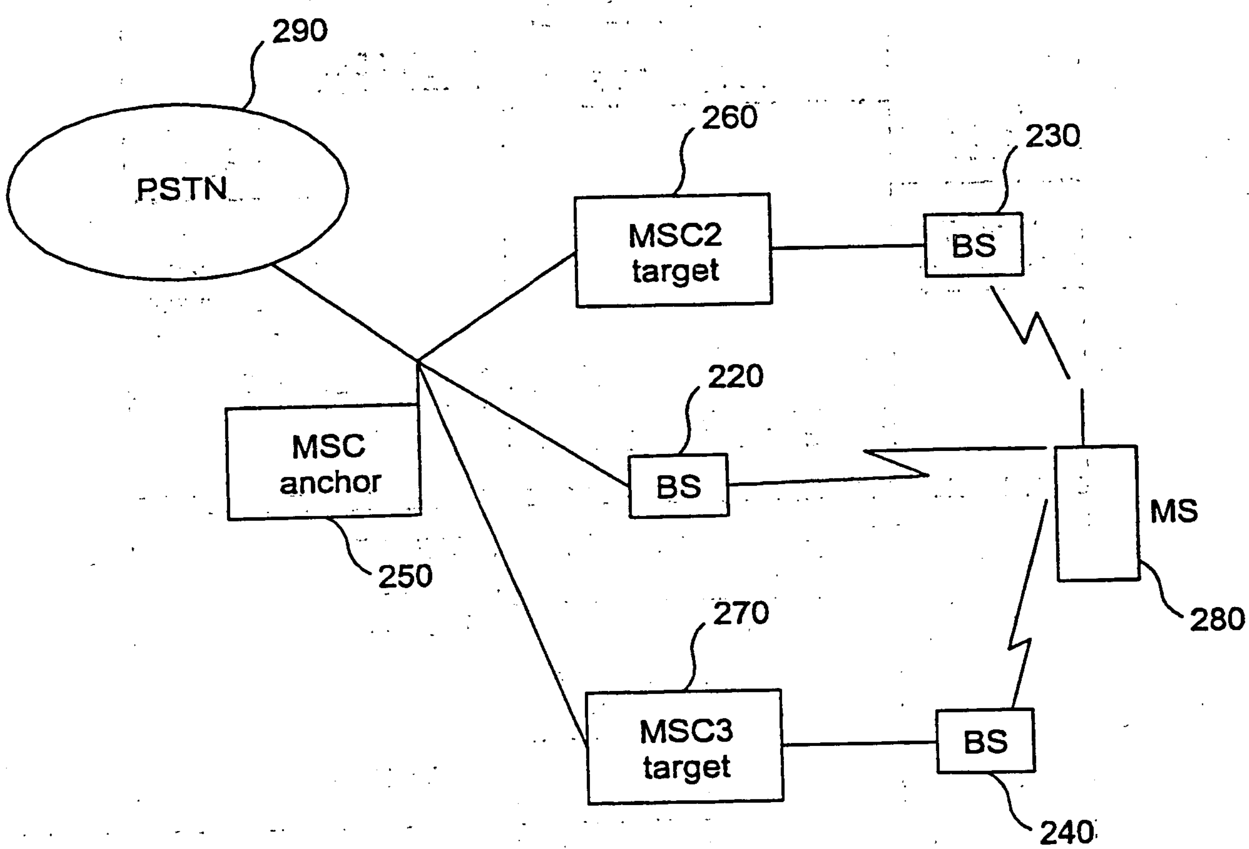

290
PSTN
260
MSC2
target
230
BS
220
BS
MSC
anchor
250
MS
280
270
MSC3
target
BS
240

Fig. 2

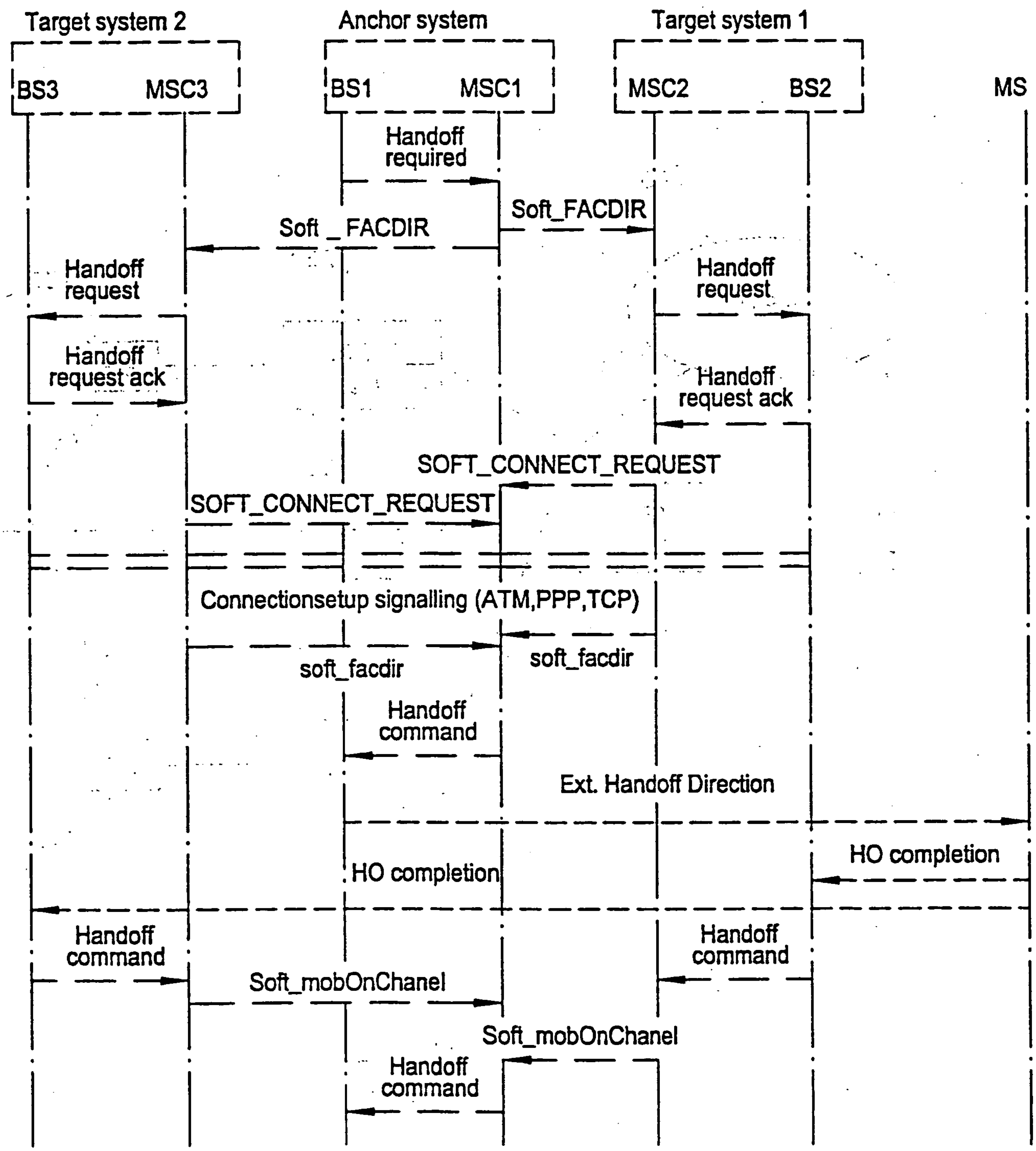

Target system 2
Anchor system
Target system 1
BS3
MSC3
BS1
MSC1
MSC2
BS2
MS
Handoff required
Soft_FACDIR
Soft _ FACDIR
Handoff request
Handoff request
Handoff request ack
Handoff request ack
SOFT_CONNECT_REQUEST
SOFT_CONNECT_REQUEST
Connectionsetup signalling (ATM,PPP,TCP)
soft_facdir
soft_facdir
Handoff command
Ext. Handoff Direction
HO completion
HO completion
Handoff command
Handoff command
Soft_mobOnChanel
Soft_mobOnChanel
Handoff command

Fig. 3

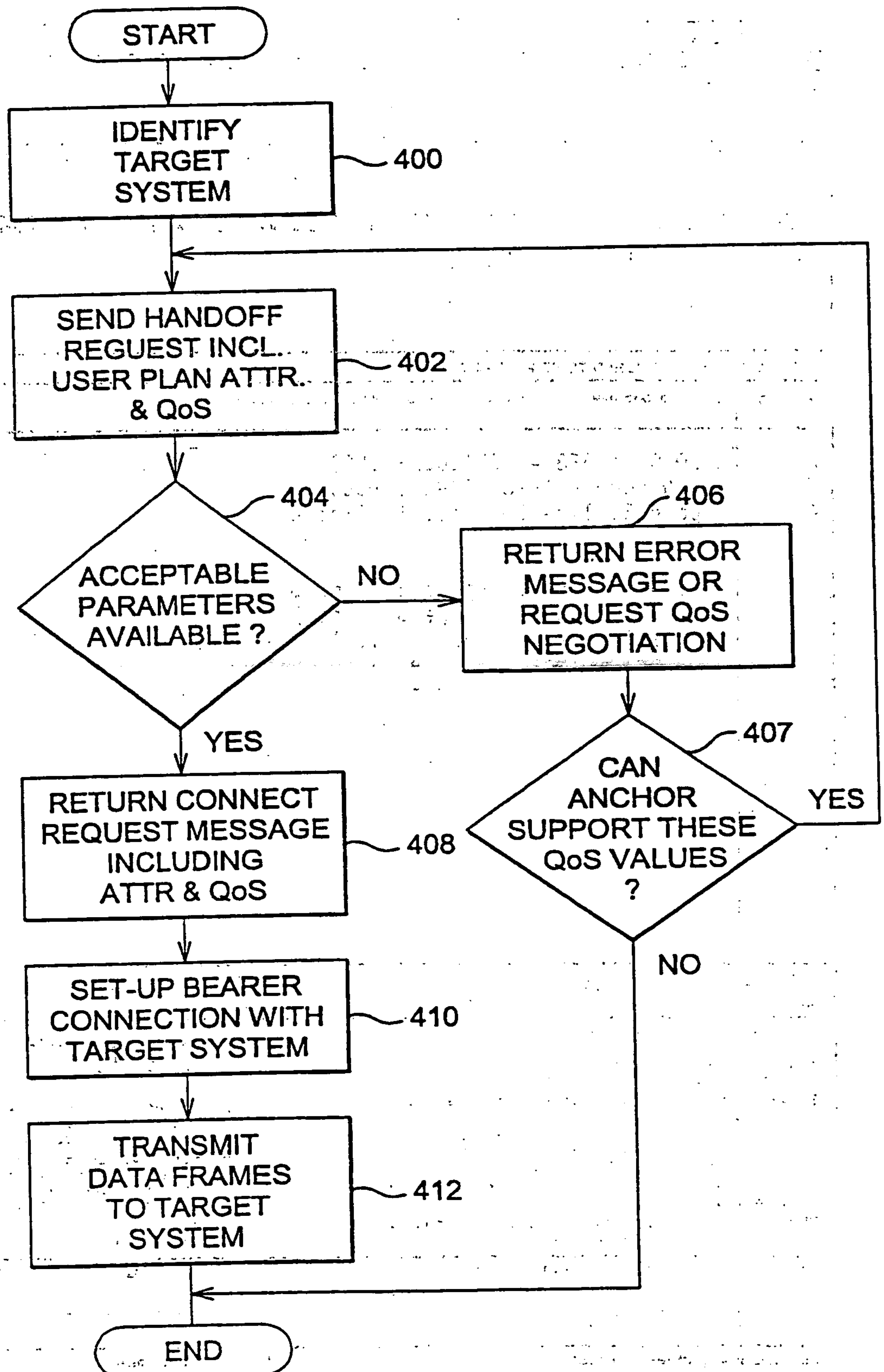

START
IDENTIFY TARGET SYSTEM
400
SEND HANDOFF REGUEST INCL. USER PLAN ATTR. & QoS
402
404
ACCEPTABLE PARAMETERS AVAILABLE ?
NO
406
RETURN ERROR MESSAGE OR REQUEST QoS NEGOTIATION
YES
407
CAN ANCHOR SUPPORT THESE QoS VALUES ?
YES
RETURN CONNECT REQUEST MESSAGE INCLUDING ATTR & QoS
408
NO
SET-UP BEARER CONNECTION WITH TARGET SYSTEM
410
TRANSMIT DATA FRAMES TO TARGET SYSTEM
412
END

Fig. 4

INTERNATIONAL SEARCH REPORT

International Application No
PCT/SE 99/02323

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04Q7/38

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal WPI PAJ INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 98 49858 A (QUALCOMM INC) 5 November 1998 (1998-11-05)	1,7,18, 19
A	page 5, line 30 -page 6, line 6 page 6, line 23 -page 8, line 3 page 8, line 35 -page 9, line 12 page 10, line 19 -page 11, line 9 page 12, line 3 - line 29	2,3, 8-10, 14-16,20

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
17 April 2000	10/05/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Heinrich, D

INTERNATIONAL SEARCH REPORT

Information on patent family members

Int. .tional Application No
PCT/SE 99/02323

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9849858 A	05-11-1998	US 6002933 A	14-12-1999
		AU 7258298 A	24-11-1998
		EP 0979584 A	16-02-2000